Modeling of shrinkage and creep stresses in concrete repair

Rahman, M.K., Baluch, M.H., Al-Gadhib, A.H.

ACI Materials Journal
Vol. 96, Issue.5, 1999

Abstract: The repair and rehabilitation of concrete structures has increased worldwide in recent years. However, the service life of concrete repair depends on the correct choice and proper use of repair materials. Mistakes in design, selection of materials, and construction practices will lead to incompatibility between the repair and the existing concrete substrate. Most of the literature reported in the field of repair reveals that dimensional incompatibility, drying shrinkage in particular, is one of the major problems of concrete repair. This paper addresses the problem of stress buildup in concrete repair in the form of a jacketed column resulting from moisture diffusion. As moisture evaporates from the external jacket into the surrounding ambience of known relative humidity, the hardened concrete column restrains free-shrinkage movement of the repair layer. As a consequence, primary tensile stresses are set up in the jacket due to restrained shrinkage. The jacketed layer under increasing tensile stresses is also subjected to tensile creep deformation, which results in a stress field of reversed sense as that due to restrained shrinkage. These secondary stresses due to restrained creep serve to relieve the primary shrinkage-associated stress field, and, as a result, the net or total stress buildup is reduced. A nonlinear finite element model is used to obtain the time-dependent moisture loss profile in the jacketed column. This model is interfaced with a finite element-based two-dimensional stress analysis program called SHCPAN for computing time-dependent restrained shrinkage and creep stresses. For a typical column repair, numerical experiments are carried out to highlight the influence of both a sealed jacket/column interface and a porous interface on the stress buildup in the jacketed columns.